

CLAIMS

What is claimed is:

1. A method of automatically adding a refrigerant to a vapor compression system comprising the steps of:
  - (a) producing a fluid stream from an internal combustion engine;
  - (b) extracting a refrigerant from the fluid stream; and
  - (c) automatically adding the refrigerant to a vapor compression system.
2. The method as recited in claim 1 further including the step of storing the refrigerant prior to step (c).
3. The method as recited in claim 2 further including the steps of sensing an amount of refrigerant in the vapor compression system and comparing the amount of refrigerant to a threshold value, and automatically adding refrigerant extracted in step (b) to the vapor compression system when the amount of refrigerant is below the threshold value.
4. The method as recited in claim 1 further including the steps of sensing an amount of refrigerant in the vapor compression system, comparing the amount of refrigerant to a threshold value, and automatically purging a predetermined amount of refrigerant from the vapor compression system when the amount of refrigerant is above the threshold value.
5. The method as recited in claim 1 wherein the stream of fluid is an internal combustion engine exhaust steam and the refrigerant is carbon dioxide.
6. The method as recited in claim 1 wherein step (b) further includes adsorbing the refrigerant on an adsorbent and desorbing the refrigerant from the adsorbent.
7. The method as recited in claim 6 wherein the refrigerant is carbon dioxide and the adsorbent is zeolite crystals, and said step of desorbing the carbon dioxide includes heating the zeolite crystals.

8. The method as recited in claim 1 wherein step (b) includes adsorbing the refrigerant on a metal salt of a metal salt solution and desorbing the refrigerant from the metal salt with heat.
9. The method as recited in claim 1 wherein the refrigerant is carbon dioxide and step (b) includes directing the fluid stream through a carbon dioxide selective membrane.
10. The method as recited in claim 1 further including the steps of compressing the refrigerant to a high pressure, cooling the refrigerant, expanding the refrigerant to a low pressure, and evaporating the refrigerant.
11. The method as recited in claim 10 further including the step of raising a pressure of the refrigerant added to the vapor compression system to said high pressure.
12. The method as recited in claim 1 wherein said internal combustion engine is utilized in a vehicle.

13. A method of automatically adding refrigerant to a vapor compression system comprising the steps of:

- (a) providing a vapor compression system having an initial amount of refrigerant;
- (b) generating a fluid stream including a supplemental supply of refrigerant;
- (c) compressing the system refrigerant to a high pressure;
- (d) cooling the system refrigerant;
- (e) expanding the system refrigerant to a low pressure;
- (f) evaporating the system refrigerant;
- (g) extracting the supplemental supply of refrigerant from the fluid stream;

and

- (h) automatically adding the supplemental supply of refrigerant to the vapor compression system to maintain a predetermined minimum amount of refrigerant.

14. The method as recited in claim 13 further including the steps of sensing an amount of refrigerant in the vapor compression system and comparing the amount of refrigerant to a threshold value, and automatically adding the refrigerant extracted in step (g).

15. The method as recited in claim 14 wherein the stream of fluid is a vehicle exhaust steam and the refrigerant is carbon dioxide.

16. A vapor compression system comprising:
  - a refrigerant source;
  - an extraction system to extract said refrigerant from said refrigerant source; and
  - a replacement system to automatically add said refrigerant to the vapor compression system to maintain a predetermined minimum amount of refrigerant in the vapor compression system.
17. The vapor compression system as recited in claim 16 further including a sensor to measure an amount of refrigerant in the vapor compression system.
18. The vapor compression system as recited in claim 17 wherein said replacement system includes a storage tank that stores said refrigerant, and wherein said replacement system automatically adds said refrigerant to the vapor compression system from said storage tank when said amount of refrigerant in the vapor compression system is below a threshold value.
19. The vapor compression system as recited in claim 17 including a purging system to purge said refrigerant from the vapor compression system when said amount of refrigerant in the vapor compression system is above a threshold value.
20. The vapor compression system as recited in claim 16 wherein said refrigerant source is a vehicle exhaust stream and refrigerant is carbon dioxide.
21. The vapor compression system as recited in claim 16 wherein said refrigerant is carbon dioxide and said extraction system includes a carbon dioxide selective membrane that allows said carbon dioxide to permeate through said carbon dioxide selective membrane to extract said carbon dioxide from said refrigerant source.

22. The vapor compression system as recited in claim 16 further including a compression device to compress said refrigerant to a high pressure, a heat rejecting heat exchanger for cooling said refrigerant, an expansion device for reducing said refrigerant to a low pressure, and a heat accepting heat exchanger for evaporating said refrigerant.